Single Aisle
TECHNICAL TRAINING MANUAL
T1+T2 (IAE V2500) (Lvl 2&3)
INERT GAS SYSTEM

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INERT GAS SYSTEM

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CONDITIONED SERVICE AIR SYSTEM D/O (3)

GENERAL

The Fuel Tank Inerting System (FTIS) includes two sub-systems:
- The Conditioned Service Air System (CSAS),
- The Inert Gas Generation System (IGGS).

The CSAS gets hot air from the Engine bleed air system and decreases its temperature to a level compatible with the IGGS sub-system.
The CSAS includes:
- The Conditioned service air system Controller Unit (CCU), which does the system control and health monitoring BITE and has interfaces with the FWS and CFDS,
- A CSAS isolation valve, which is a protection of the system if there is low pressure, over pressure or over temperature,
- A heat exchanger to decrease the air temperature.

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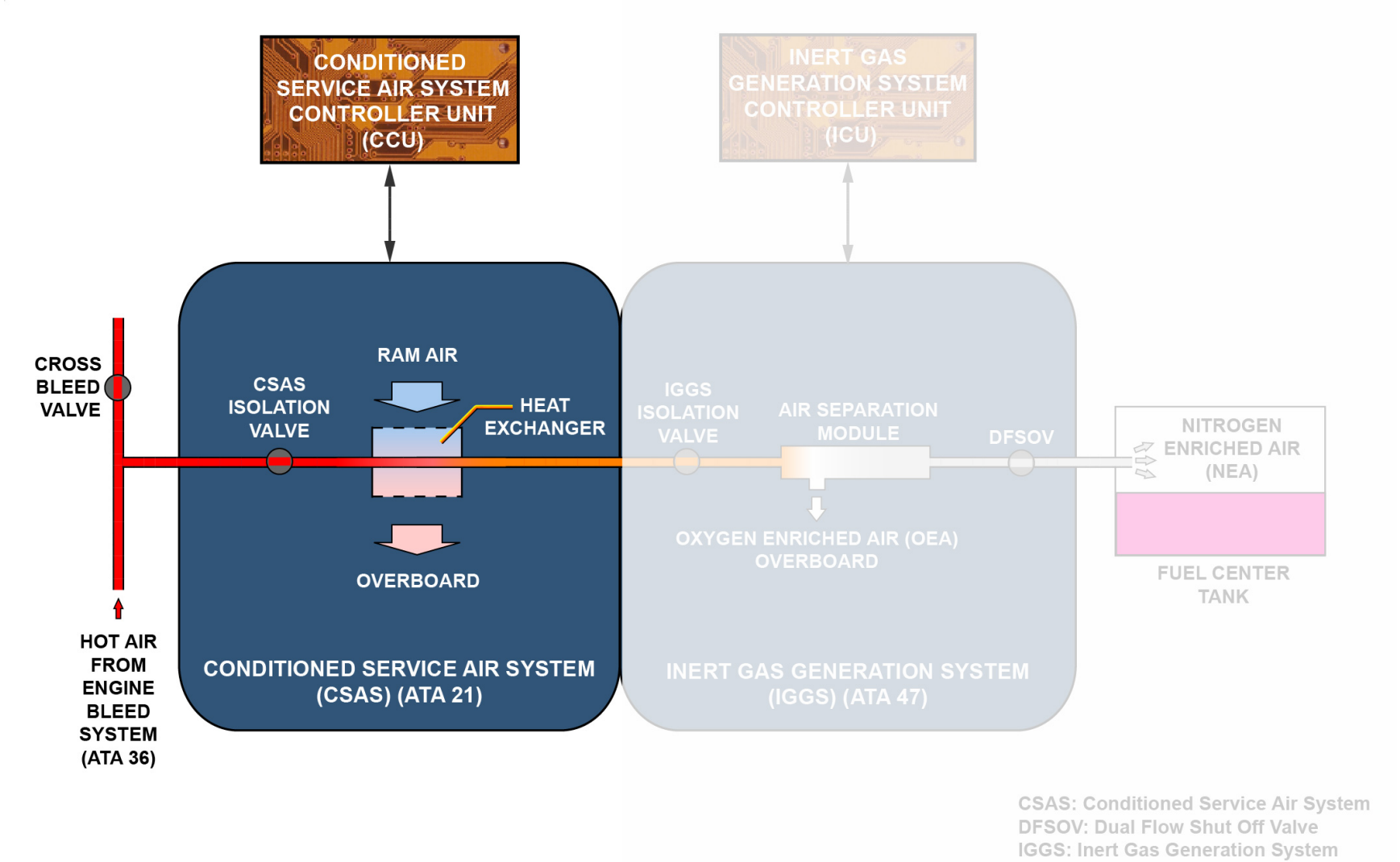
CONDITIONED SERVICE AIR SYSTEM CONTROLLER UNIT (CCU)
INERT GAS GENERATION SYSTEM CONTROLLER UNIT (ICU)
CROSS BLEED VALVE
CSAS ISOLATION VALVE
RAM AIR
HEAT EXCHANGER
OVERBOARD
IGGS ISOLATION VALVE
AIR SEPARATION MODULE
DFSOV
NITROGEN ENRICHED AIR (NEA)
OXYGEN ENRICHED AIR (OEA) OVERBOARD
FUEL CENTER TANK
HOT AIR FROM ENGINE BLEED SYSTEM (ATA 36)
CONDITIONED SERVICE AIR SYSTEM (CSAS) (ATA 21)
INERT GAS GENERATION SYSTEM (IGGS) (ATA 47)
CSAS: Conditioned Service Air System
DFSOV: Dual Flow Shut Off Valve
IGGS: Inert Gas Generation System

GENERAL

CONDITIONED SERVICE AIR SYSTEM D/O (3)

SYSTEM DESCRIPTION

Engine 1 is the primary bleed source and Eng 2, through the X Bleed valve, is the secondary bleed source.
APU or Ground Cart supply can be used for interactive test on Ground.
The CSAS gets bleed air from the Engine Bleed Air System and does its conditioning for the IGGS.
First, the ozone converter decreases the quantity of ozone in the bleed air to give protection to the IGGS components.
Then, the air temperature is decreased by the CSAS heat exchanger to get a temperature of 60°C+/-6°C.

TEMPERATURE AND PRESSURE CONTROL

The bypass valve is installed in the heat exchanger bypass duct and is controlled by the CSAS. The bypass valve adds hot air downstream of the heat exchanger to maintain the temperature within limits.
On the output duct, a dual element temperature sensor and a pressure sensor monitor the temperature and the pressure before they go into the IGGS.
If there is over-pressure or over-temperature, the CSAS isolation valve closes to stop the system.

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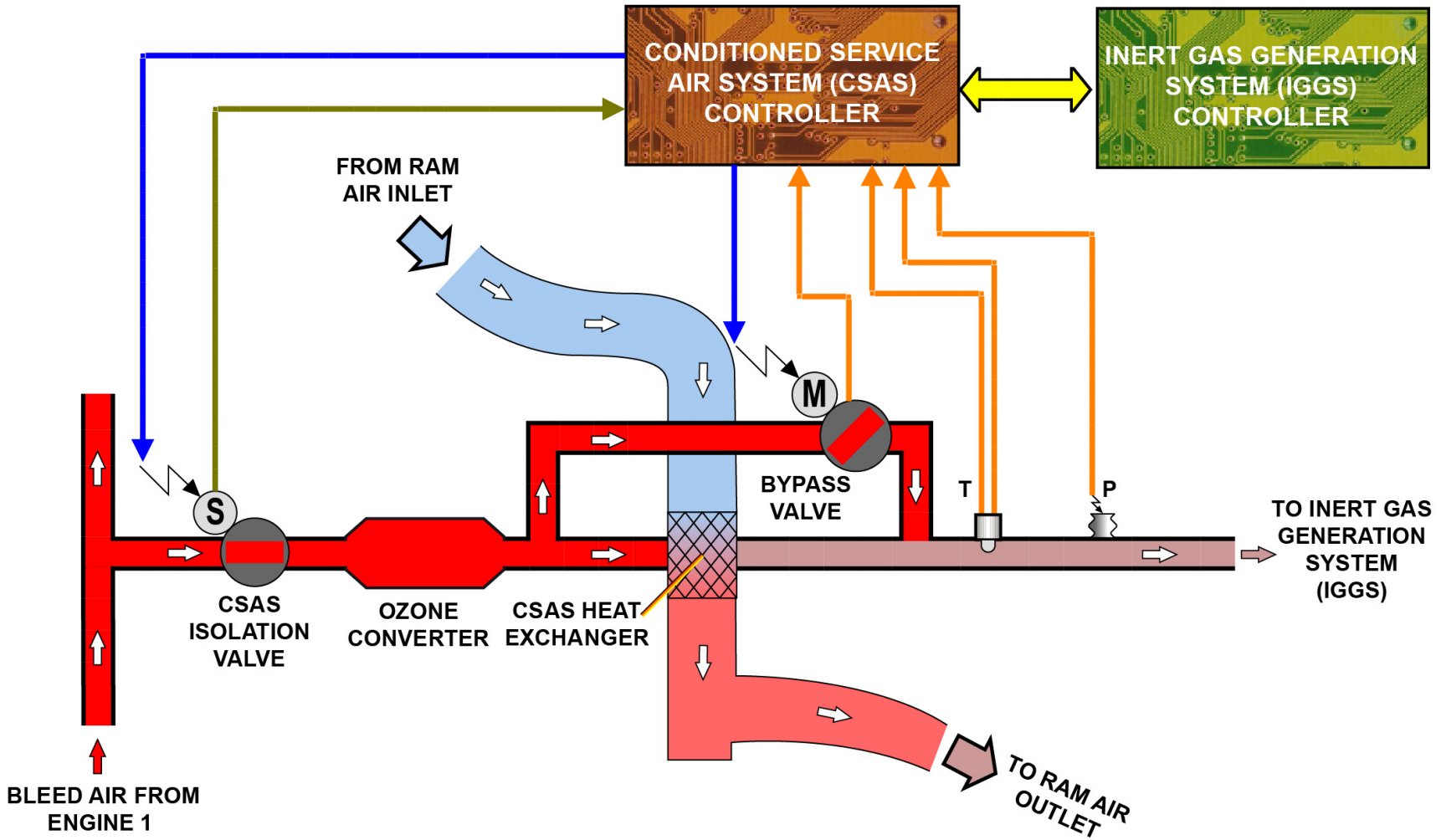

SYSTEM DESCRIPTION - TEMPERATURE AND PRESSURE CONTROL

CONDITIONED SERVICE AIR SYSTEM D/O (3)

SYSTEM DESCRIPTION (continued)

CSAS OPERATION

The system is installed on the left hand side of the aircraft belly fairing. The bleed air is pulled from the High Pressure Ground Connector (HPGC) tube. In normal operation, the CSAS isolation valve is open to let the air go through the ozone converter. After the Ozone converter, the air temperature is decreased by the CSAS heat exchanger. The output of the heat exchanger is connected to the IGGS.

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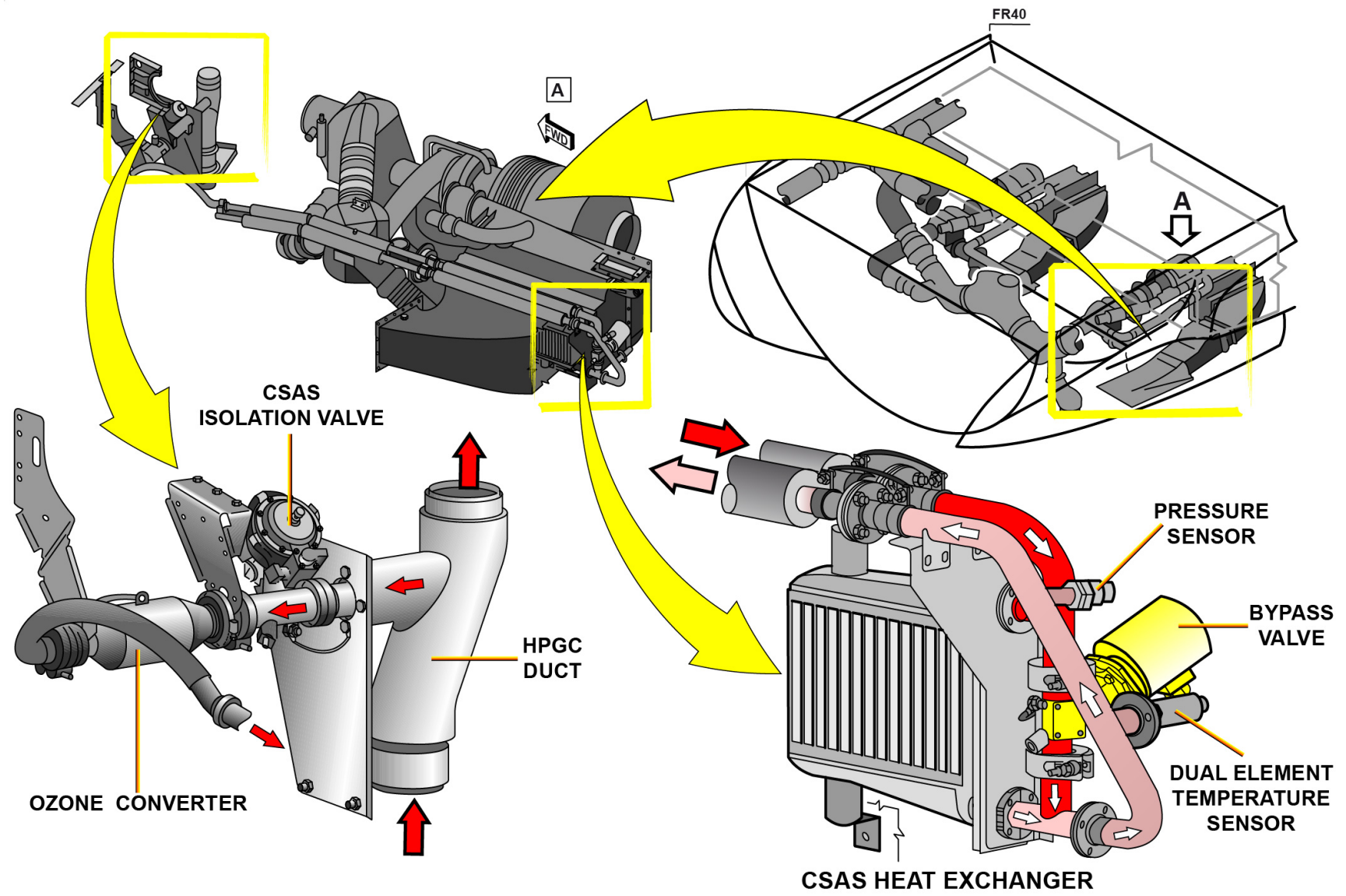


SYSTEM DESCRIPTION - CSAS OPERATION

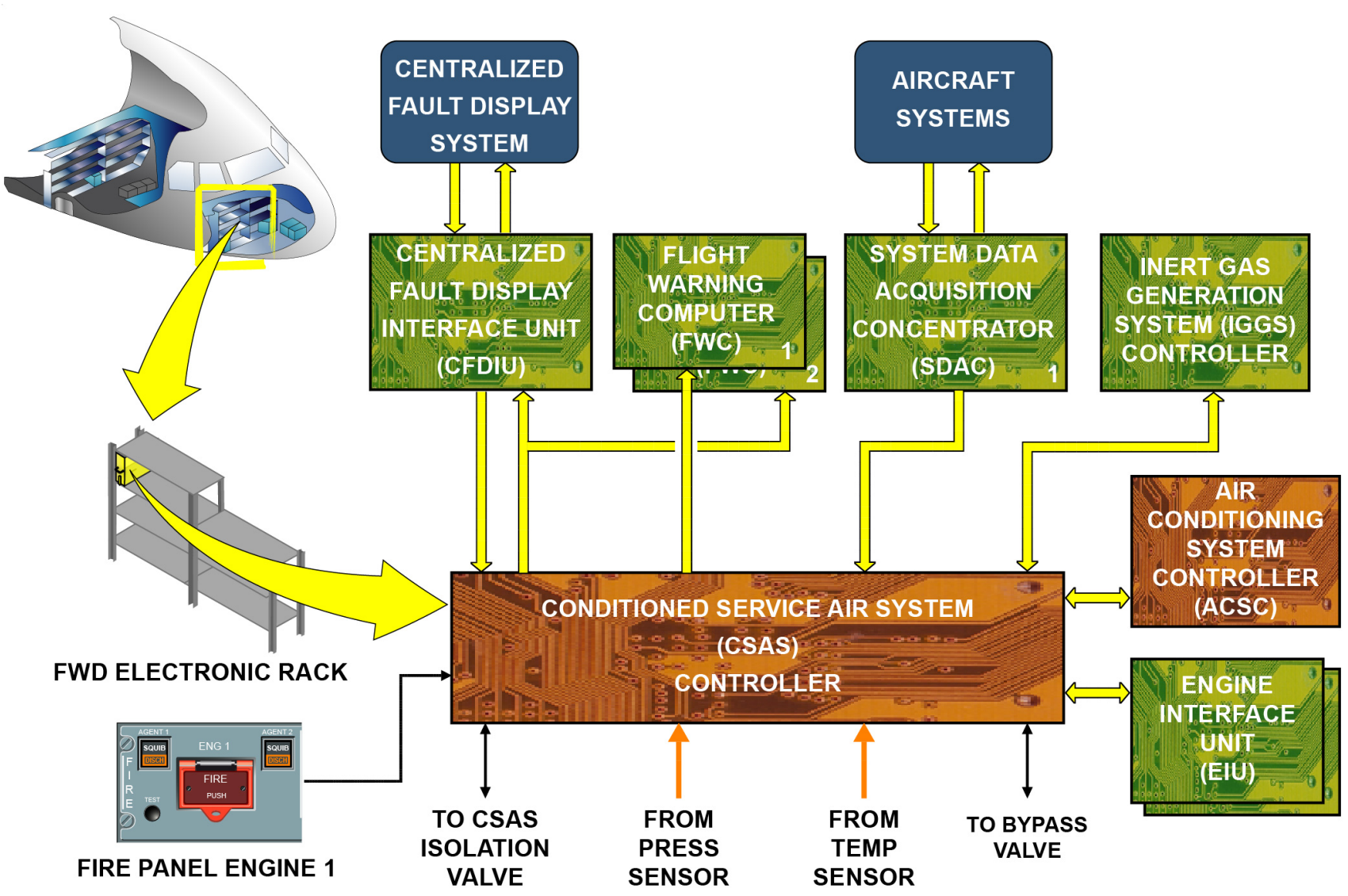
CONDITIONED SERVICE AIR SYSTEM D/O (3)

CSAS INTERFACES

The CSAS controller is installed in the FWD electronics rack (90VU) in the avionics compartment.
It does the system control and health monitoring BITE and has interfaces with the Flight Warning System (FWS) and the maintenance computer.
If a failure of the CSAS system occurs, the status message "INERT FAULT" will come into view only in flight phase 1 and 10, for maintenance.

NOTE: The MEL tells that the A/C can be dispatched with the system unserviceable for 10 days with no maintenance procedure.

The CSAS Controller is interconnected between Air Conditioning System Controller (ACSC) and Engine Interface Units (EIUs) to keep a minimum bleed pressure during descent.



CSAS INTERFACES

INERT GAS GENERATION SYSTEM D/O (3)

GENERAL

The Fuel Tank Inerting System (FTIS) includes two sub-systems:
- The Conditioned Service Air System (CSAS),
- The Inert Gas Generation System (IGGS).

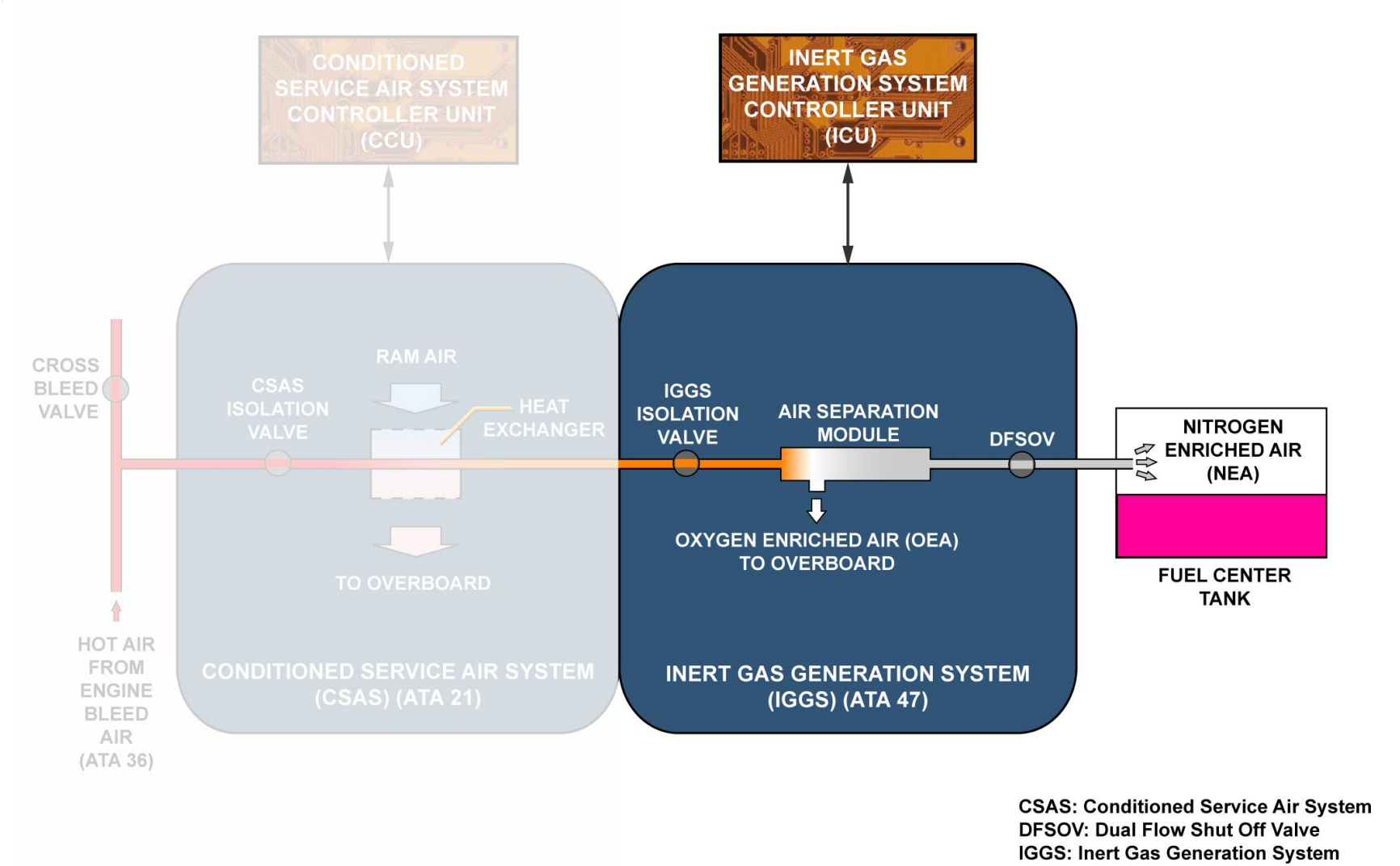
The IGGS uses an Air Separation Module (ASM) to remove oxygen from the conditioned air stream. This makes and separates the Nitrogen Enriched Air (NEA) and the Oxygen Enriched Air (OEA). The OEA is sent overboard.

The Dual Flow Shut Off Valve (DFSOV) controls the NEA flow to the center fuel tank, lets the system change between low/middle/high NEA flow and isolates the IGGS from the center fuel tank.

The IGGS controller supplies system control and health monitoring/BITE.

The IGGS isolation valve is a solenoid valve. It is spring-loaded closed. During operation, the IGGS Controller Unit (ICU) controls the valve to open, to let conditioned air from CSAS to the IGGS.

It closes if too low a pressure and/or overtemperature air come from the heat exchanger.


CONDITIONED SERVICE AIR SYSTEM CONTROLLER UNIT (CCU)
INERT GAS GENERATION SYSTEM CONTROLLER UNIT (ICU)
CROSS BLEED VALVE
CSAS ISOLATION VALVE
RAM AIR
HEAT EXCHANGER
IGGS ISOLATION VALVE
AIR SEPARATION MODULE
DFSOV
NITROGEN ENRICHED AIR (NEA)
OXYGEN ENRICHED AIR (OEA) TO OVERBOARD
TO OVERBOARD
FUEL CENTER TANK
HOT AIR FROM ENGINE BLEED AIR (ATA 36)
CONDITIONED SERVICE AIR SYSTEM (CSAS) (ATA 21)
INERT GAS GENERATION SYSTEM (IGGS) (ATA 47)
CSAS: Conditioned Service Air System
DFSOV: Dual Flow Shut Off Valve
IGGS: Inert Gas Generation System

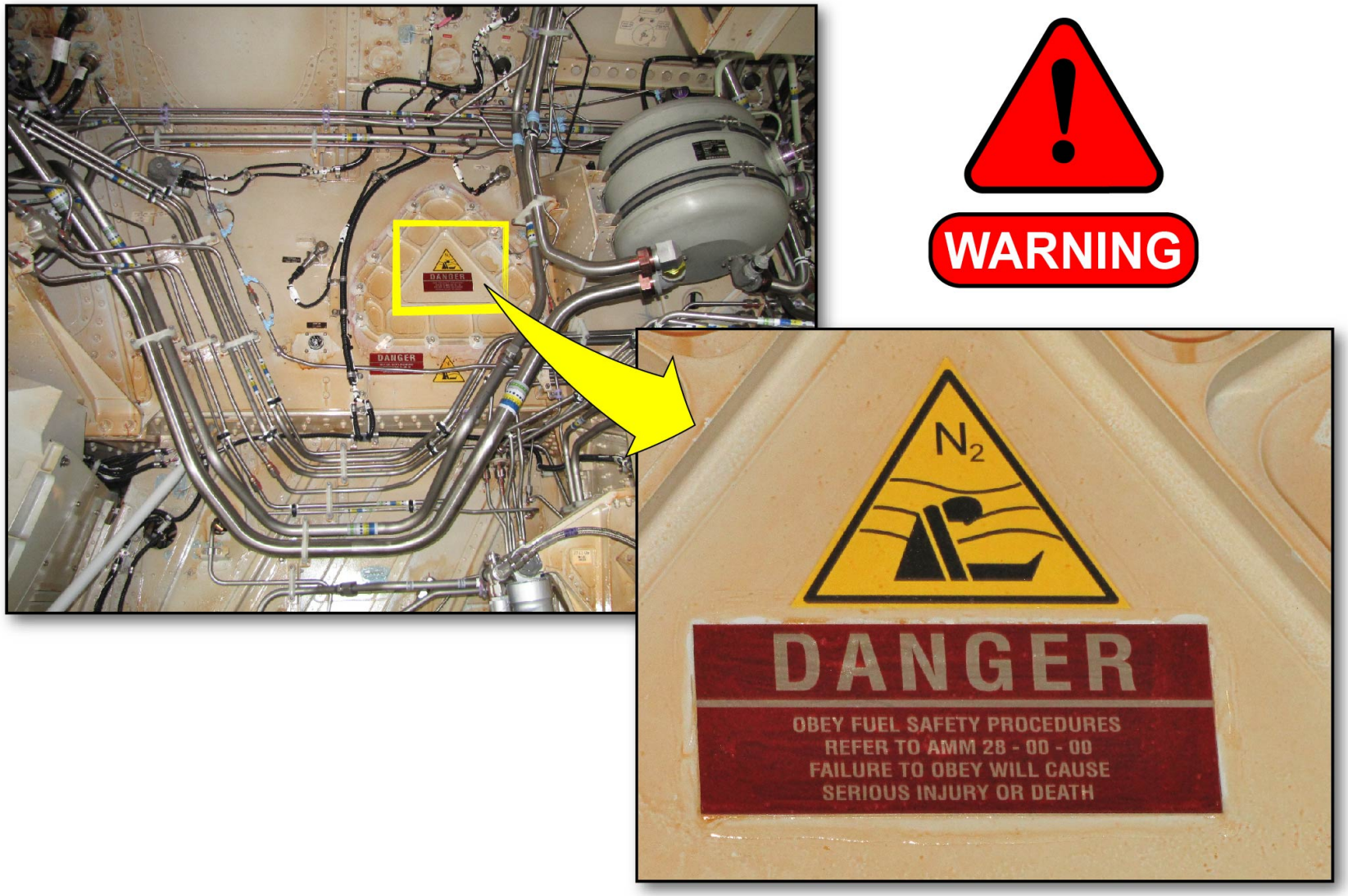
GENERAL

INERT GAS GENERATION SYSTEM D/O (3)

GENERAL (continued)

SAFETY PRECAUTION

The FTIS supplies NEA, which is a gas with a low oxygen content and can cause an asphyxiation risk to the personnel if this gas is in confined spaces.



GENERAL - SAFETY PRECAUTION

INERT GAS GENERATION SYSTEM D/O (3)

SYSTEM DESCRIPTION

To inert the center fuel tank and to control and monitor the IGGS, the IGGS includes:
- one IGGS Isolation Gate Valve,
- one D-ULPA (Double ultra low particle) filter,
- one temperature sensor,
- two pressure transmitters (inlet and outlet of the ASM),
- one oxygen sensor at the outlet of the ASM,
- one Air Separation Module (ASM),
- one Dual Flow Shut Off Valve (DFSOV),
- one dual flapper check valve,
- one IGGS Controller Unit (ICU).

SYSTEM OPERATION

NORMAL OPERATION

The bleed air comes from the CSAS and it is filtered by the D-ULPA filter to keep the ASM inlet clean, without hydrocarbons and dust. Downstream of the D-ULPA filter, one temperature sensor and one pressure sensor send air parameters to the ICU. The ASM, which is the core of the IGGS, removes oxygen and sends NEA to the center fuel tank. The OEA is sent overboard through an outlet on the HPGC door. Downstream of the ASM, an oxygen sensor measures the oxygen rate to prevent a high oxygen concentration in the center fuel tank. The oxygen sensor has a pressure sensing capability when it is energized and thus it prevents over-pressure in the center fuel tank. The DFSOV controls the NEA flow to the center fuel tank and lets the system change between low/mid/high NEA flow in relation to the flight phases. The DFSOV also isolates the IGGS from the center fuel tank if an abnormal operation occurs. A Dual Flapper Check Valve makes a double barrier to the possible back-flow of fuel.

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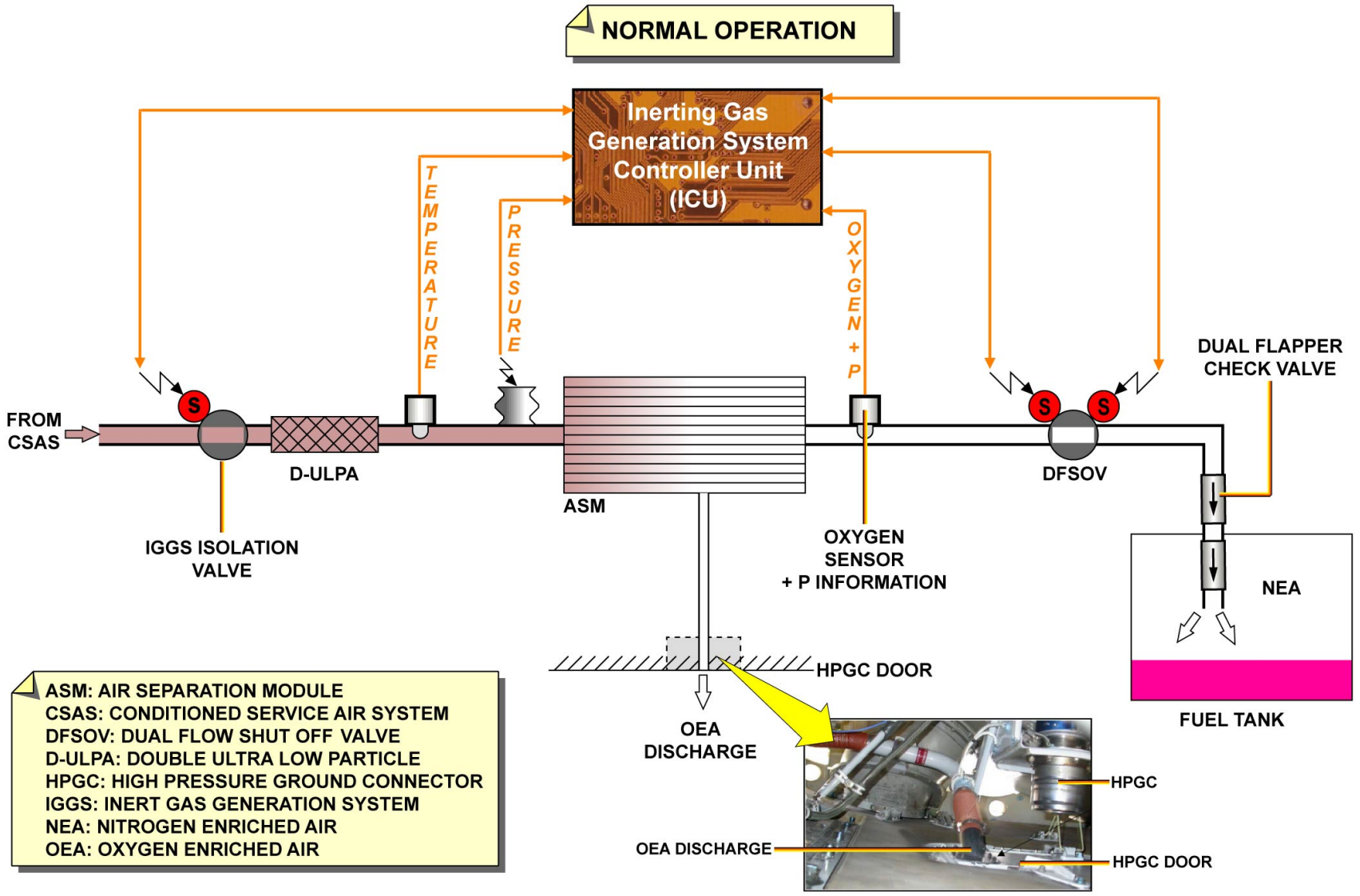

SYSTEM DESCRIPTION & SYSTEM OPERATION

INERT GAS GENERATION SYSTEM D/O (3)

SYSTEM OPERATION (continued)

ABNORMAL OPERATION

If there is overpressure or overtemperature, the ICU de-energizes the IGGS Isolation Gate Valve solenoid to close the IGGS Isolation Gate Valve.

If the oxygen sensor senses an oxygen rate higher than 12%, the ICU de-energizes the IGGS Isolation Gate Valve solenoid and the DFSOV solenoid to close the IGGS Isolation Gate Valve and the DFSOV.

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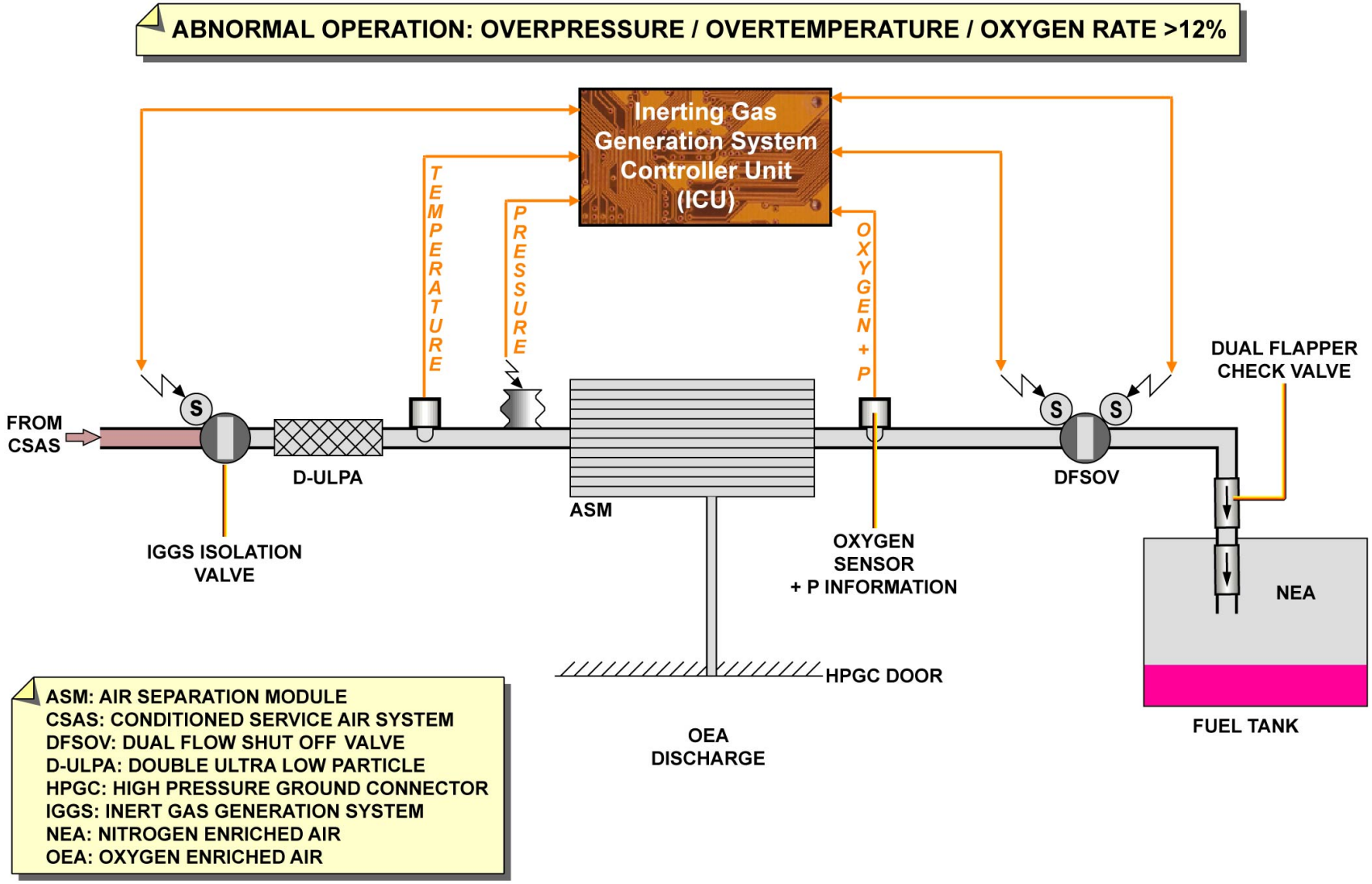

SYSTEM OPERATION - ABNORMAL OPERATION

INERT GAS GENERATION SYSTEM D/O (3)

COMPONENT DESCRIPTION

AIR SEPERATION MODULE (ASM)

The ASM is the core of the Inert Gas Generation System. It removes oxygen from the compressed air stream. It makes Nitrogen Enriched Air (NEA) and Oxygen Enriched Air (OEA). The NEA is sent to the center fuel tank and the OEA is sent overboard.
An ASM is a semi-permeable hollow-fiber membrane bundle contained in a pressure containment canister.

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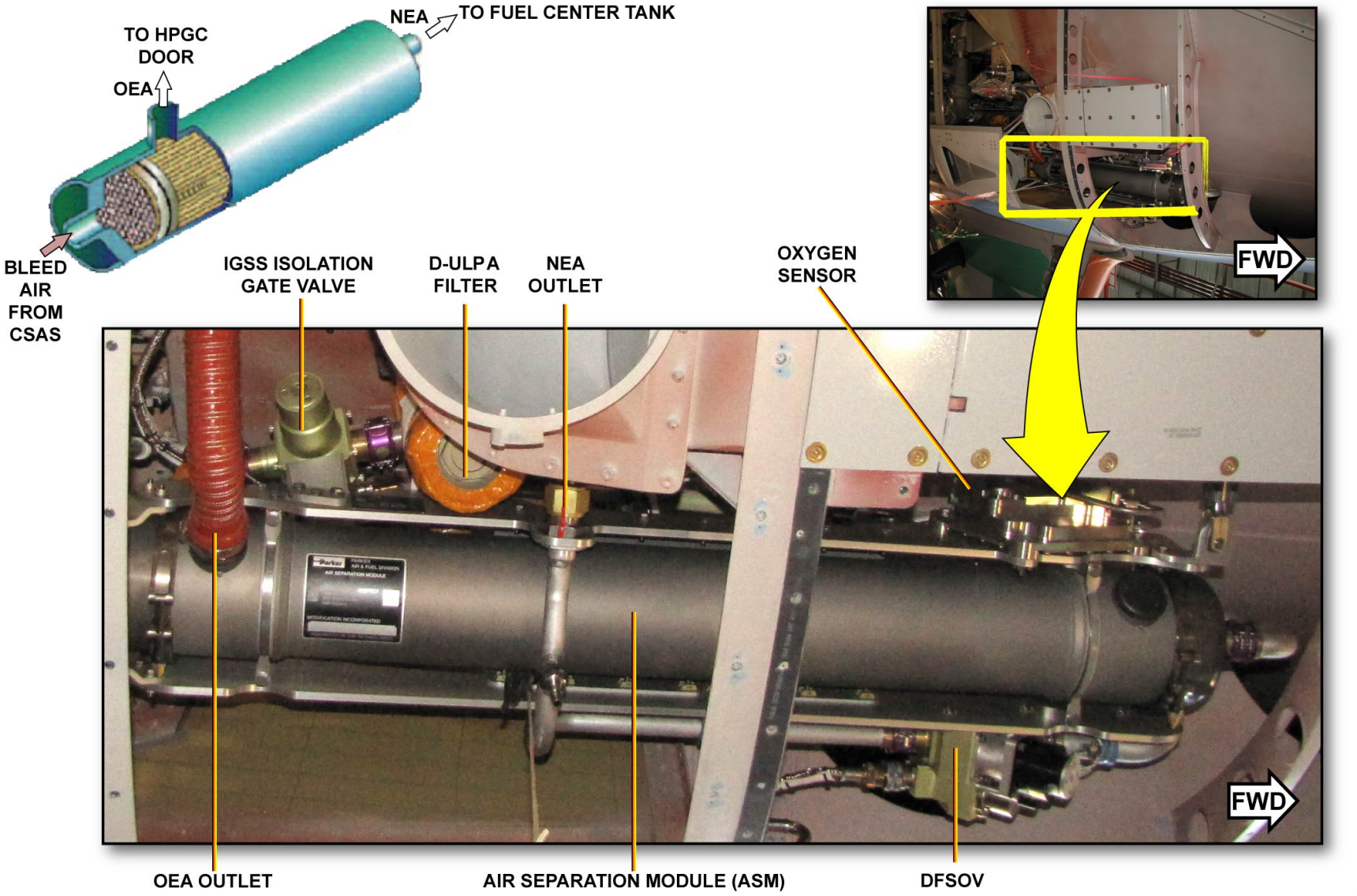

COMPONENT DESCRIPTION - AIR SEPERATION MODULE (ASM)

INERT GAS GENERATION SYSTEM D/O (3)

COMPONENT DESCRIPTION (continued)

DUAL FLOW SHUT OFF VALVE

In normal operation, the DFSOV is closed and isolates the IGGS from the center fuel tank.
The ICU supplies the two solenoids of the DFSOV to control the DFSOV position (OPEN/CLOSE) and to control the NEA flow (LOW/MI/HIGH)

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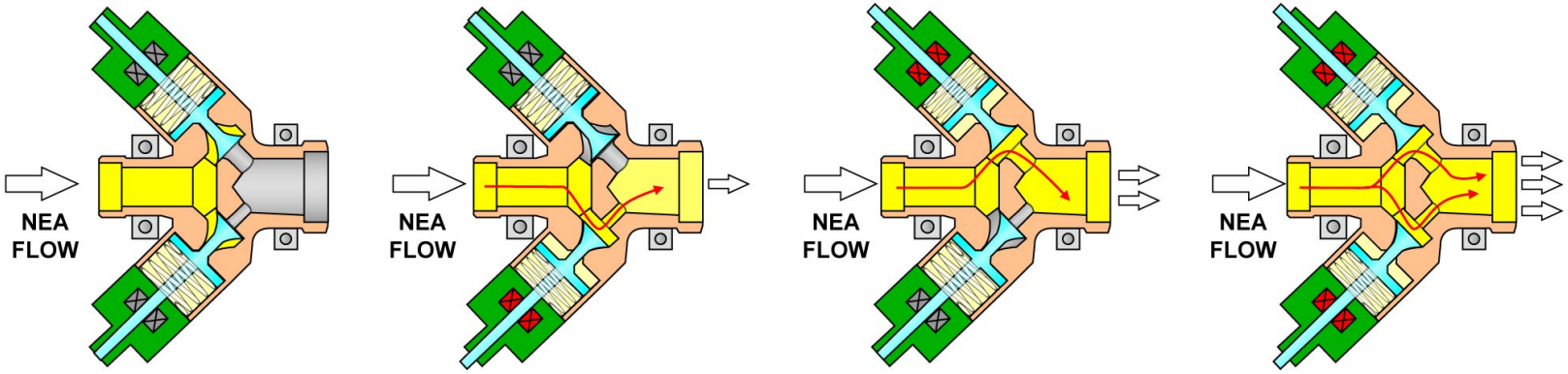
DUAL FLOW SHUT-OFF VALVE



CLOSED POSITION | LOW FLOW POSITION | MIDDLE FLOW POSITION | HIGH FLOW POSITION

COMPONENT DESCRIPTION - DUAL FLOW SHUT OFF VALVE

INERT GAS GENERATION SYSTEM D/O (3)

COMPONENT DESCRIPTION (continued)

DUAL FLAPPER CHECK VALVE

NEA is supplied from the IGGS to the center fuel tank by the distribution pipe and nozzle.
A twin check valve system prevents fuel ingress from the center fuel tank back to the IGGS.
The system is contained in one housing that includes two in-line flapper type check valves (Dual flapper check valve). These valves are on the outer side of the center fuel tank.

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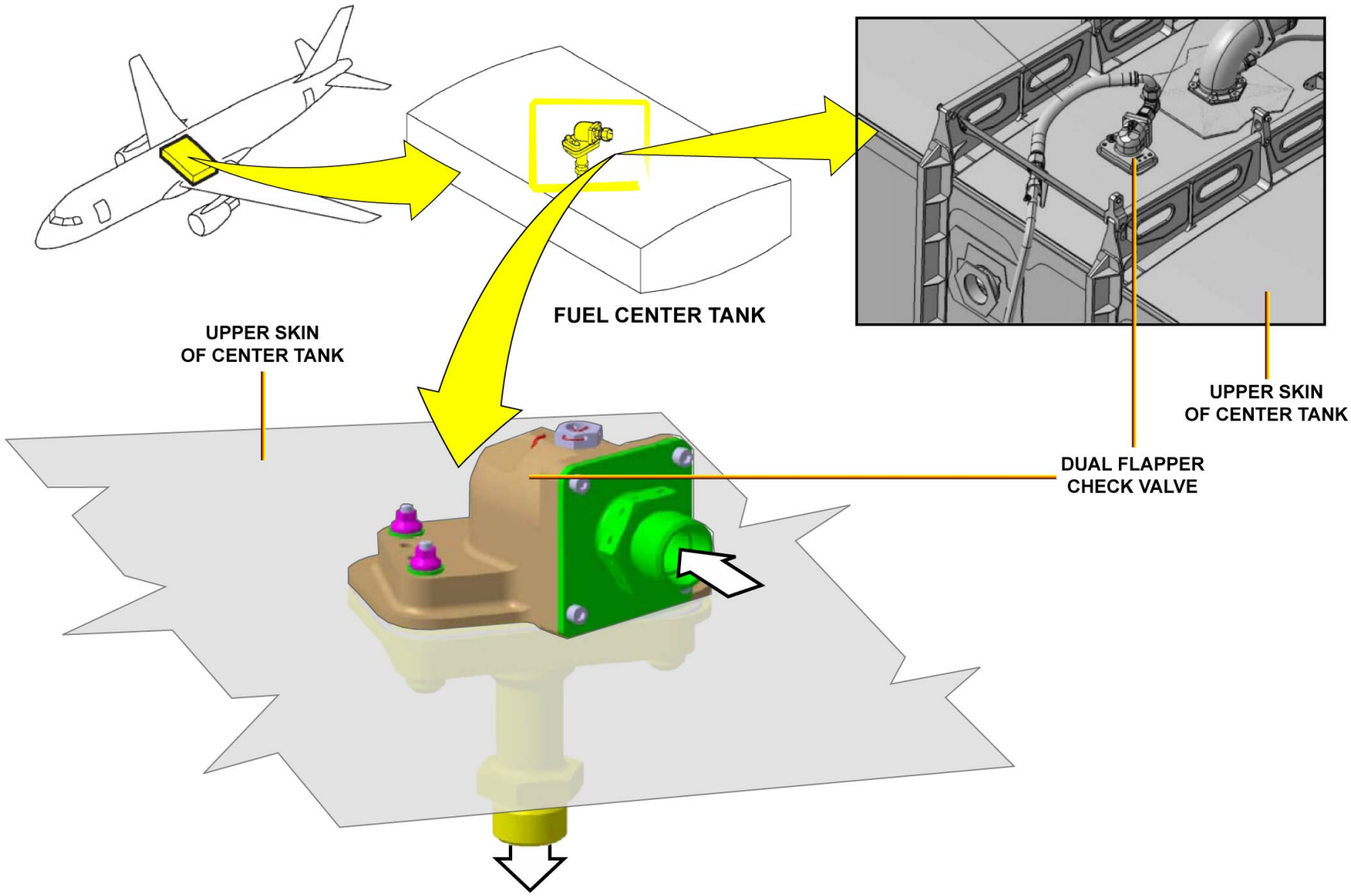
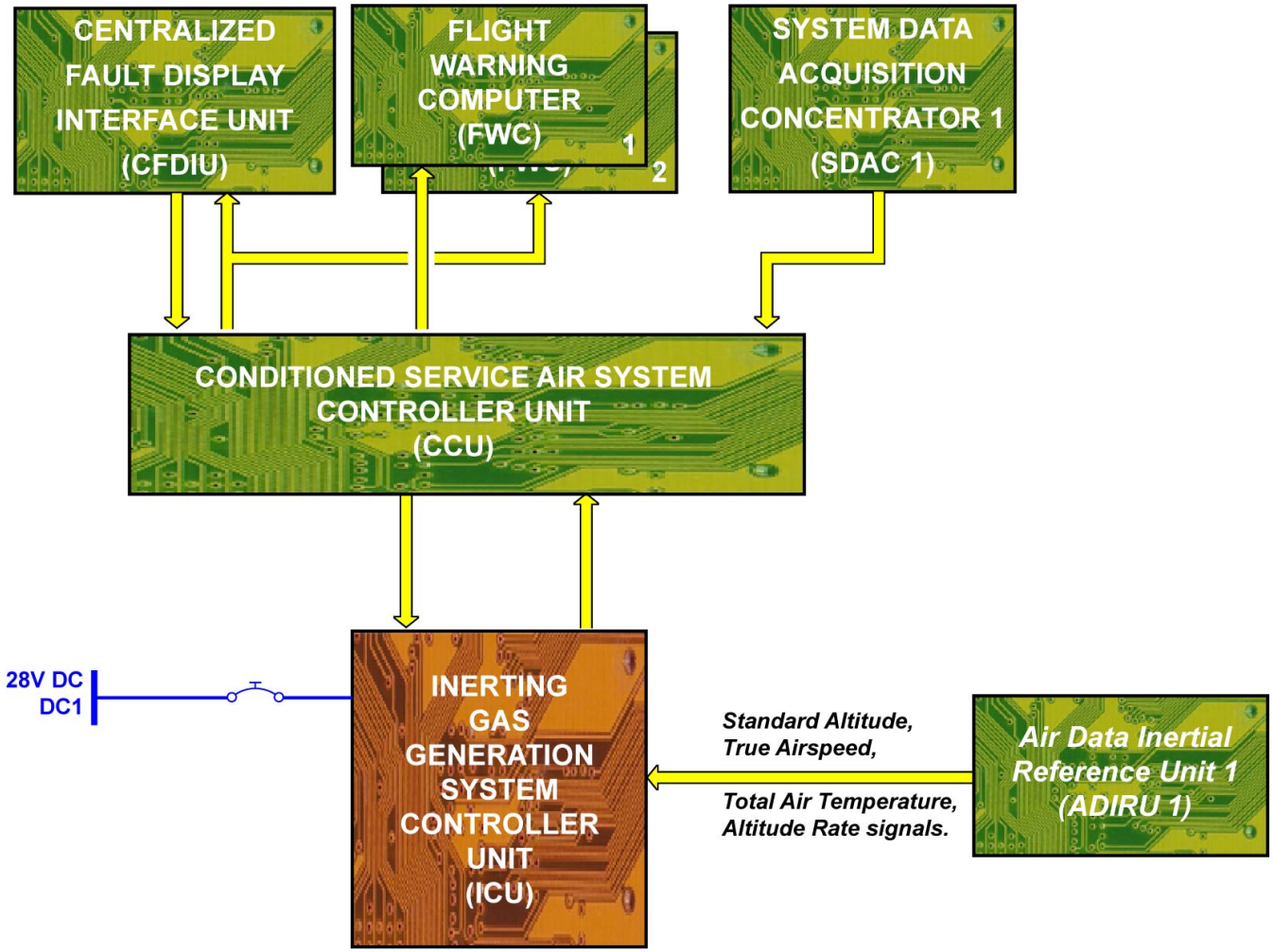


COMPONENT DESCRIPTION - DUAL FLAPPER CHECK VALVE

INERT GAS GENERATION SYSTEM D/O (3)

ICU INTERFACES

The ADIRU 1 supplies Standard Altitude, True Airspeed, Total Air Temperature and Altitude Rate signals to the ICU.
The CCU makes the communication possible between the IGGS controller, the CFDIU and the FWS. The communication between the two controllers is also used to give the condition of each system. For example, if the CSAS stops because of an overtemperature scenario, the CCU will tell the ICU that the system is closed and they will compare the readings of the sensors that come from the two systems.


CENTRALIZED FAULT DISPLAY INTERFACE UNIT (CFDIU)
FLIGHT WARNING COMPUTER (FWC) 1
2
SYSTEM DATA ACQUISITION CONCENTRATOR 1 (SDAC 1)
CONDITIONED SERVICE AIR SYSTEM CONTROLLER UNIT (CCU)
28V DC DC1
INERTING GAS GENERATION SYSTEM CONTROLLER UNIT (ICU)
Standard Altitude, True Airspeed,
Total Air Temperature, Altitude Rate signals.
Air Data Inertial Reference Unit 1 (ADIRU 1)

ICU INTERFACES

INERT GAS SYSTEM INDICATING (2)

INERT GAS SYSTEM CFDS MENU

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